one centimeter in diameter was removed from the lower portion of the left ureter. This incision failed to heal completely and continued to drain urine. In spite of this, on September 30, a stone was removed from the lower portion of the left ureter through a similar incision. This wound also continued to drain urine intermittently. On April 14, 1945, urinary drainage stopped from both sides. The patient ceased to pass any urine at all through his bladder and he became very ill. He began to have recurring chills and fever, nausea, vomiting. He lost much weight. Because of all this he entered the hospital on April 25, 1945.

The examination at that time showed a poorly nourished, anæmic looking white male. He was passing not more than 25 c.c. of urine per day—a culture of which showed *Staph. aureus* and pyocyaneus. The urine was loaded with pus and erythrocytes. On the abdomen there were bilateral scars, 12 to 13 cm. long in the lower abdomen. The right seemed newly healed. The left was draining slightly from several sinuses. The blood showed a urea nitrogen of 28.0 mgm. and a creatinine of 3.5 mgm. per 100 c.c. Plain film showed many small stone shadows in the lower portion of the left kidney. Excretory urograms showed no function on the right with some function on the left with extreme dilatation of the left kidney pelvis and ureter. Attempts were made to pass ureteral catheters up to the kidney pelves. These were unsuccessful. On the right the catheter went up about 8 cm.; on the left only 2 cm. Obstruction on the right was complete and no skiodan solution could be forced by it. On the left side some of the skiodan solution came out through the abdominal fistula. The rest followed up the ureter visualizing a distorted, very much dilated ureter (Fig. 5). On May 2, 1945, the right ureter was exposed extraperitoneally in the region of the constriction and for some distance above and below this. The scar tissue was in part sidetracked and the much dilated proximal and distal portions of the ureter mobilized and anastomosed with interrupted No. 00 chromic catgut sutures over a No. 8 ureteral catheter and a No. 12 T tube which was inserted into the ureter through a small stab wound about 3 cm. above the region of the anastomosis.

On May 11, a pyelogram was made through the splinting catheter. The patient steadily improved, excreting large quantities of urine through the splinting catheter, the end of which came out through the urethra. However, he still drained urine from the fistula on the left side. The T tube was removed on the 14th postoperative day and the ureteral catheter a few days later. When this was done, the patient passed large quantities of urine through the bladder, showing that the right kidney had resumed its function. He left the hospital on June 18, greatly improved. Blood urea nitrogen and creatinine were normal, he was feeling well, passing much urine through the bladder, but still draining urine from the fistulæ on the left side.

The patient continued to gain in strength, but otherwise his condition remained unchanged. He therefore entered the hospital on October 1, 1945, for an operation on the left side to cure him of the constant urinary drainage there. The excretory urogram at this time, showed function on the right with much hydronephrosis and hydroureter. No function was present on the left. A ureteral catheter passed up to the renal pelvis easily on the right. On the left, obstruction was met 2 cm. from the ureteral orifice. On October 5, an operation was performed on the left side with the intent of carrying out a procedure similar to the one performed on the right side. This was impossible because of the very extensive scarring on the left side of the bony pelvis and destruction by scarring of the distal 10 cm. of ureter. Also the proximal ureter was greatly dilated and its wall was considerably thickened. After much deliberation an anastomosis by the method described and illustrated above was carried out. The patient got along nicely, the splinting catheter and suprapubic tube were both removed in two weeks and the bladder permitted to heal, which it did promptly. On November 7,—three weeks after removal of the splinting catheter—the new orifice could easily be catheterized and a No. 7 catheter passed into the left renal pelvis. No ureteral reflux or other abnormality could be demonstrated by cystogram (Fig. 6). The patient left the hospital voiding normally with all wounds healed on November 24. On March 18, 1946, his condition had remained excellent and his urine showed only a few pus cells per high power field.

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RADIOLOGY AND THE GENERAL PRACTITIONER*

By Bede J. Harrison, M.B.

Vancouver, B.C.

"WHAT is essential is invisible to the eye" [Exupéry]. These words draw attention to the epidemic of nominalism which with its usual sequelæ has spread so widely among us in recent years. The avalanche of material things which pours from the production line has so affected man that he finds it difficult to think otherwise than in terms of material things. Hence all around us we see the symbol becoming confused with the thing it represents.

The taint affects our own profession. Surgical interference is mistaken for treatment. Diseases are mistaken for patients; histological slides for diseases; x-ray apparatus for radiographs, and radiographs for diagnoses.

Such professional mistakes are made less frequently by the medical expert than by the medical amateur, but no branch of the profession has escaped entirely. The percentage of radiological amateurs among the whole of the members of the profession is quite high. Many of them seem to think that any x-ray film has its full story plainly written in the photographic emulsion for anyone to read who wishes. Many medical men who would not think of expressing an opinion on a histological slide seem to think that they can unravel the whole of the story written on the x-ray film and they have no hesitation in carrying out treatment based upon that opinion. To all such amateurs I would recommend the words quoted above: "What is essential is invisible to the eye".

* Read at the Seventy-seventh Annual Meeting of the Canadian Medical Association, General Session, Banff, Alberta, June 12, 1946.

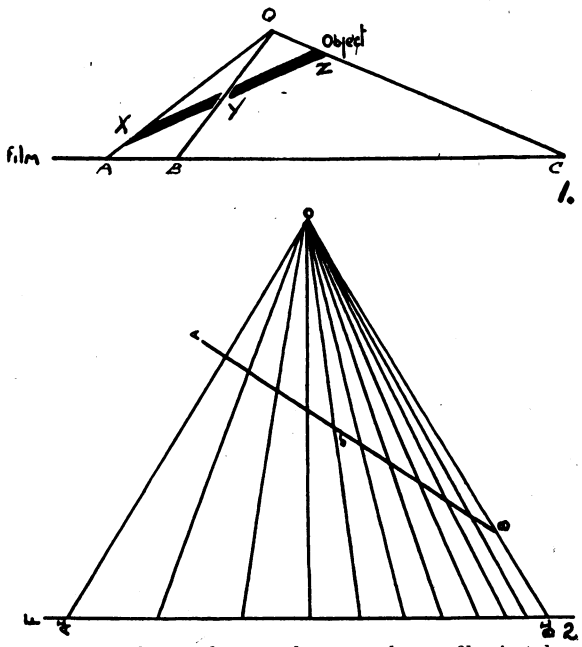

Fig. 1.—Shows what can happen when a film is taken of an object, the thick line, divided into two equal parts —XY and YZ. With the tube at O, the two equal parts cast shadows AB and BC respectively on the film. Examination of the film will show two shadows of grossly unequal length despite the equality of XY and YZ. If XYZ represent the shaft of the femur with the lower end at X, the upper end at Z, and a fracture at Y, the film could quite easily be interpreted as disclosing a fracture in the lower fourth of the shaft, instead of at the mid-point where it has really occurred. **Fig. 2.**—Extends the same principle and shows how with the tube at O equal lengths of an object AB can cast images of unequal length on the film A^1B^1. The disparity between the shadows of two successive segments is relatively small but the disparity between the fragments at the extreme ends is quite large. Radiographs which show many vertebræ on the same film can produce this very misleading appearance, the vertebræ at one end appearing much larger than the vertebræ at the other end. This point is of very great importance when one is attempting to estimate the horizontal distance between the two pedicles of a vertebra in cases where an intraspinal tumour is suspected.

With only partial understanding of the correlation between the clinical findings and the particular type of x-ray investigation most suitable to elucidate them, with practically no understanding of the basic principles of technique, and with complete ignorance of the laws of perspective, projection and penetration, the amateur radiologist still will proceed to infer the presence or absence of a pathological condition in his patient with the help of x-ray films for the production and explanation of which he lacks the necessary basic knowledge.

The importance of this basic knowledge will be amply demonstrated by the following illustrations.

COMMENT

From the foregoing studies some important lessons can be learned. (1) The technique must be adapted to the particular nature of the object to be radiographed. (2) The radiographer must know the nature of the thing he wishes

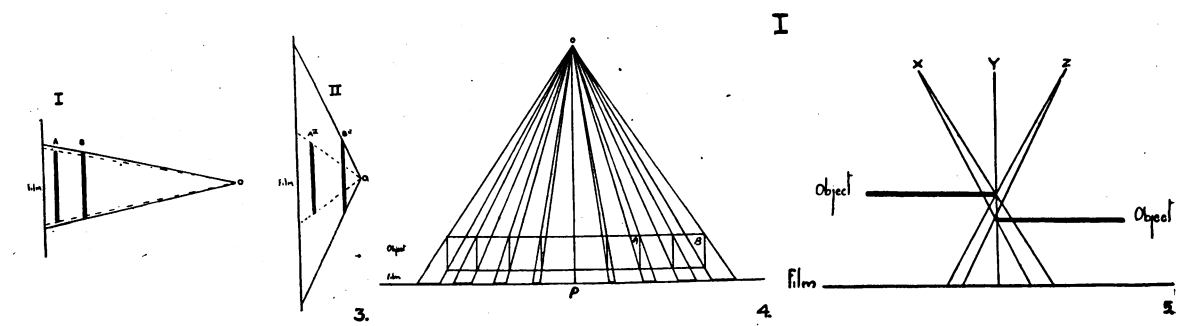

Fig. 3.—Shows how much a technical detail, in this case alteration of distance, can affect appearances. In I two bodies of equal lengths are radiographed with the tube at O at a great distance from the film. These two bodies produce shadows of unequal length though the disparity between them is slight. When the tube O is brought close to the film, as in II, the disparity in the shadows of the bodies is very great though again they are actually of equal length. Such disparities are observed between chest films taken, as in I, at the usual six-feet distance in the x-ray department, and those taken, as in II, at thirty inches, with the mobile x-ray unit in the ward. In attempting to interpret such radiographs of the chest, these factors must be taken into account. **Fig. 4.**—Shows the images of objects of equal length A and B which lie at right angles to the film. Although A and B are obviously of equal length, their images show great disparity and it will be noted that other objects of equal length show shorter images the closer they are to the central ray and longer images the further away from the central ray OP. Examination of the vertebral column produces this effect, the discal surfaces of the bodies giving images which are increasingly exaggerated as we pass away from the central ray. **Fig. 5.**—Shows the projection of two separated bodies, taken with the tube in various positions, X, Y and Z. When the tube is placed at X, the two images representing the two bodies will overlap. If the tube be placed at Y, the images will just touch; and if the tube be placed at Z, the images will be separated. When the two objects are fragments of the shaft of a bone such as the femur, it is possible for the radiograph to show them in a position of overlapping, as with the tube in position X, or with no overlapping and no separation, as with the tube in position Y, or as being completely separated, as with the tube in position Z, thus leading to a very erroneous interpretation of the relative positions of the fragments.

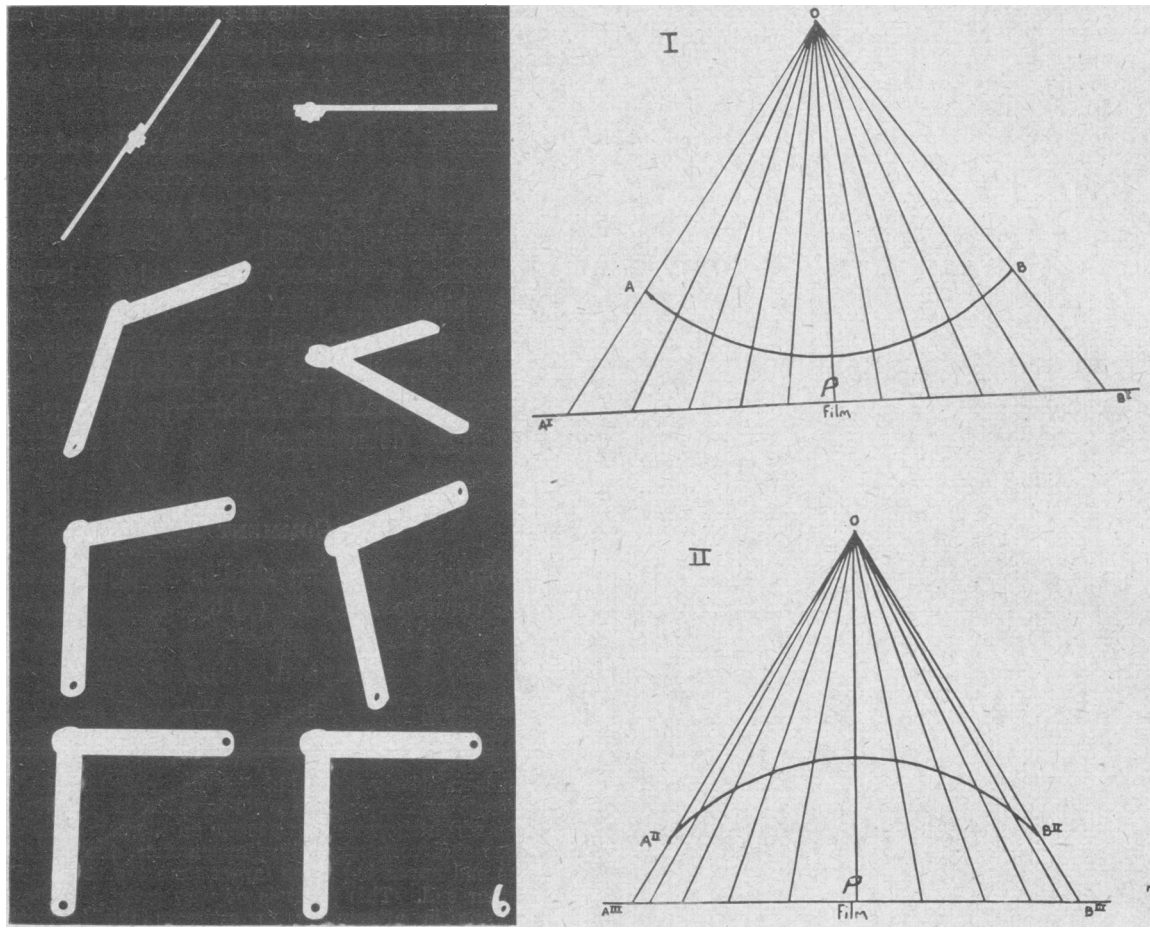

Fig. 6.—Shows what can happen in the radiography of bodies lying at various angles to each other. The first row shows four radiographs, each taken of the same two metal bars kept constantly at right angles to each other. We can see that by varying the positions of the tube, and the object with reference to the film, we can produce any obtuse angle up to the right angles as a radiographic representation of a right angle. The second row shows radiographs of the same two bars still at right angles to each other. It illustrates how a right angle can be made to appear upon the film as an acute angle lying somewhere between ninety and zero. Similarly, we can make actual obtuse angles appear on the radiograph as acute angles. This is well shown in the second member from the top of both series, one showing a wide obtuse angle and the other, a markedly acute angle; yet both are radiographs of the same right-angled structure. This factor has a particular meaning in estimating the degree of coxa vara or coxa valga and also in determining the degree of angulation between the two fragments of a fractured long bone. **Fig. 7.**—Is a radiograph indicating the result of taking films of curves. The upper part shows a curve, concave towards the tube O. Here we can see that the images on the film cast by equal lengths of the curve grow gradually greater, the further the segment of the curve is distant from the central ray OP. The lower half shows a curve convex towards the tube O. Here the images cast by equal lengths of the curve grow gradually smaller the further the segment of the curve is distant from the central ray OP. In taking radiographs of the skull, one is always faced with the situation where a convex and a concave curve are both present, the concave curve being close to the film and the convex curve being away from the film. The one side of the skull shows exaggeration; the other side, diminution of detail as we pass away from the central point. The films indicate that when, what I call the four corners of the skull, are under suspicion, advantage must be taken of the principles here laid down if we wish to disclose as much of the bony detail of the skull as possible.

to portray before deciding on his technique. (3) Various structures will require different radiographic approaches. (4) Since radiography is essentially aimed at differentiating between several conditions it is necessary for the radiographer to be aware of the conditions to be differentiated in order that he may adjust his technique accordingly. (5) The radiographer must be supplied with a differential diagnosis in order that he may eliminate by technical methods as many of the differentials as possible. (6) In interpretation of any film whatsoever a thorough knowledge of the physical conditions underlying the taking of the radiograph as well as the physical principles inculcated here is necessary.

Our experience with interns educated at seven Canadian medical schools, eleven medical schools in the United States, three medical schools in Great Britain and four medical

schools in non-English-speaking centres, would indicate that they are not being trained along the lines suggested above.

How should clinical radiology be taught? Before we consider this, we must understand the nature of radiographic evidence.

A film is a record of tissue density. Hence, only those tissues can be differentiated, the densities of which differ from the densities of the surrounding structures. Some of these differences are natural. Where no natural differentiation in density exists, it may be produced artificially by the injection or ingestion of radiopaque material such as barium sulphate.

The demonstration of pathological changes in tissues can be made therefore only if the changes produce some alteration in the size, shape or position of the density representing those tissues, or some increase or diminution in the degree of density itself. The x-ray film

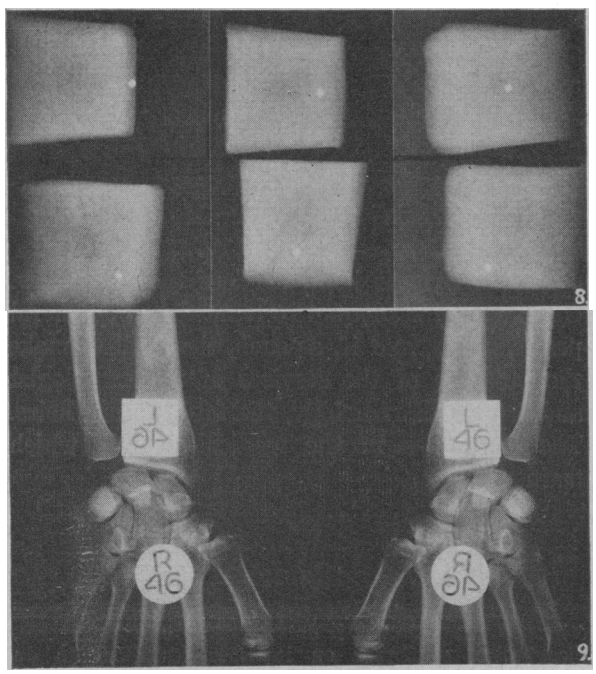

Fig. 8.—Shows a series of radiographs of a paraffin block with a small piece of metal embedded in one edge. One view, the upper left, shows the metal in its proper relationship to the block. Each of the other five shows a false relationship. It is quite easy to realize that a foreign body may appear to be situated anywhere in the tissues except in its real location and especially to imagine that a foreign body lies in a bone when really it is only at the surface. Our analysis of our immediate visual impressions is based on our past experience of visual impressions and their relationship to reality.

Fig. 9.—Shows how this past experience must be modified, in the analysis of x-ray films. Our past experience has taught us that when an object hides another from our view the one we see is closer to us than the one hidden. On the right half we see a metallic square hiding the image of the radius. We know, if we judge from our past experience, that the metallic square is closer to us than the radius, but this film was actually taken with the square further away from us than the radius, a relation which, under ordinary circumstances, would result in the square being hidden by the radius. On the same film the round metallic object actually lies closer to us than the metacarpus which it hides in exactly the same way as the square hides the radius. This illustrates what is called the prepotence of the opaque and the psychological hazard in interpretation which it produces must be constantly kept in mind or it will lead us into serious pitfalls. The left-hand film again demonstrates our inability to determine whether an opaque material is closer to, or further away from us than the objects which it hides.

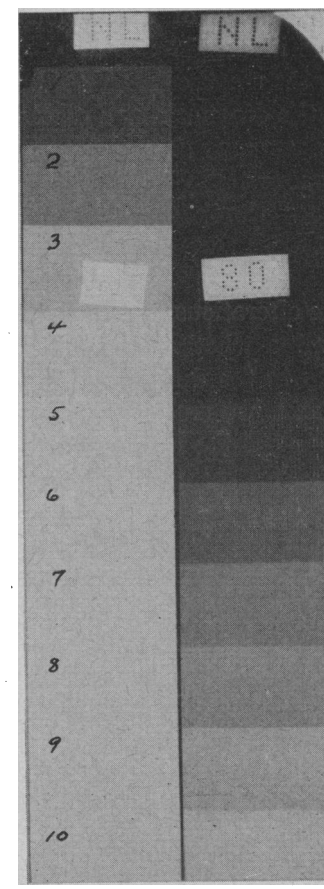

Fig. 10.—Shows us two radiographs of a step-ladder made of thin lead sheets. They were taken under different techniques, one intended to show mainly the thick and the other mainly the thin parts of the ladder. This they do quite successfully. No variation in ordinary visible lighting could possibly produce such a variation in the appearance of the same step-ladder. The number 80 on the right-hand half appears much closer to us than does the number 40 on the left, and the background of the 80 appears much further away from the 80 than the background of the 40 appears to be behind that figure; yet, both the 40 and the 80 and their respective backgrounds are all on the same plane. This is another example of the prepotence of the opaque. Proper technique is necessary to show up the 80 or the 40, as may be required. So, too, proper technique can show up radiographic changes which are confined to bone or are confined to the soft tissue on the other hand, or involve both the bone and the surrounding soft tissues. It is obvious that our normal visual impressions give us no help in such cases as were indicated in Figs. 9 and 10. They tend rather to confuse us unless complete mental analysis accompanies the interpretation of the visual impressions.

does not record changes in histological anatomy; it is evidence only of changes in the gross anatomy.

To determine whether an x-ray examination is likely to demonstrate any lesion we must ask ourselves what changes in the gross anatomy that lesion produces. For example, in the case of an injury to the knee, what changes will a fracture or a synovitis or a lip-hæmarthrosis produce which can alter the normal density relationships of the various structures in the tissues involved?

To determine whether an x-ray investigation can help in the diagnosis of a disease, we must ask what tissues may show such lesions as will produce demonstrable density changes. For example, does the particular type of blood dyscrasia of which we are thinking cause any changes in the bones, thereby producing demonstrable alterations in radiological density?

To determine whether the x-ray investigation can help in the differential diagnosis of a patient's illness, we must ask similar questions regarding each of the different diseases entering into the differential. For example, in paralysis of the recurrent laryngeal nerve, we may suspect lesions arising in the lungs, the œsophagus, the aorta, the heart or the other mediastinal tissues. We must ask ourselves which of these lesions can produce such changes in tissue density as are demonstrable. In this way, we can ascertain whether x-ray investigation is likely to be of help.

We must dismiss at once the idea so widely prevalent that a student should be taught to recognize a disease from the film. We must remember that he is being trained as a general practitioner and that the basis which will help him most is the knowledge of what lesions and what diseases can produce radiological changes. Instead of working from the film back to the disease the student must be taught to look in the other direction, and to proceed from the differential diagnosis to the x-ray investigation.

The progress of events should be as follows: (*a*) the determination of the list of differential diagnoses by the clinician; (*b*) consultation of the clinician with the radiologist, at the bedside if necessary, as to how the differential may be solved or reduced by x-ray investigation; (*c*) radiological investigation of the tissues and organs as laid down by the radiologist, repeated and extended as he considers necessary; (*d*) examination by the radiologist of the films and fluoroscopic findings obtained after the necessary investigations, and the determination of the radiological differential diagnosis; (*e*) consultation between the clinician and radiologist to align the radiological and the clinical differentials.

Some of these steps may be shortened. Not a single one may be omitted, if the greatest help is to be obtained for the patient.

Until medical students are taught along the lines indicated, they will continue to ask for such things as a gastro-intestinal series, a chest, a knee and so on. They will continue to think that a diagnosis should be made from an x-ray film, instead of going in the other direction and working forward from the clinical differential diagnosis to the suitable radiological examination.

As the twig is bent, so does the tree grow. Our medical students are trained to be general practitioners, and if, as such, they fail to make the best use of the services of the radiologist and the art of radiology, the fault is not theirs. The fault lies in the medical schools which trained them.

Vancouver General Hospital.

RÉSUMÉ

Le practicien ne doit pas se servir du film pour étiqueter une maladie; il doit procéder en sens inverse, c'est-à-dire, confirmer ou infirmer les éléments du diagnostic différential par la radiographie.

Il doit encore retenir que la technique radiologique est éminemment variable selon les cas, que le radiologue doit être au courant de la nature de la lésion recherchée et des différents diagnostics envisagés et qu'une bonne interprétation exige la connaissance de tout le dossier du malade. Le temps radiologique du diagnostic devra être l'occasion d'une consultation avec le clinicien, et au besoin, avec divers spécialistes selon les cas. Ces principes bien compris et appliqués assureront un meilleur enseignement de la radiologie et mettront fin à une tendance trop répandue à la médecine expéditive.

JEAN SAUCIER

D.D.T. FOR HEAD LICE

Q.—Is D.D.T. efficacious and safe to use on a verminous head? How should it be applied?

A.—D.D.T. can be used in the form of a 2% emulsion against head lice. (See the article by E. B. S. Scobbie in *Brit. M. J.*, **1**: 409, 1945.) It is fairly certain that one or two such treatments would be harmless, but the effects of repeated applications are not known. We understand that experiments are now in progress to ascertain the effectiveness of D.D.T. aqueous suspensions for this purpose. Such preparations would clearly be safer than emulsions owing to the absence of any solvent for the D.D.T.—*Brit. M. J.*, September 21, 1946.